

**HONG KONG CHEMISTRY TEACHERS' BELIEFS  
ABOUT AND PRACTICES OF USING  
INFORMATION AND COMMUNICATION TECHNOLOGY  
FOR TEACHING AND LEARNING**

Raymond Wai-hung FONG

Faculty of Arts and Social Sciences  
University of Technology Sydney  
2011

## ABSTRACT

The study focused on the use of information and communication technology or ICT based tools in chemistry teaching in secondary schools in Hong Kong. Local chemistry teachers were invited to participate in this study, as they are crucial in implementing ICT for teaching in schools. More specifically, the study aimed to develop an understanding on the following aspects.

1. What kinds of ICT-based teaching tools teachers are using?
2. What are teachers' perceived usefulness and perceived ease of use of ICT-based teaching tools?
3. What are teachers' context beliefs about the use of ICT-based teaching tools?
4. What are the relationships between the use of ICT-based teaching tools and teacher beliefs?

In order to answer these questions, a survey questionnaire was used to gather data about whether local chemistry teachers (N=124) were using ICT for teaching and how frequent were ICT tools being used. Then, in-depth interviews with five purposefully selected teachers, supplemented by document analysis were conducted. The data collected were analyzed using descriptive and inferential statistical analytical techniques, as well as constant comparison method. As there were no existing researches that focus on how local chemistry teachers make use of ICT, the findings of this study should contribute to the understanding in this domain. Furthermore, the findings could be illustrative reference for whether or not chemistry teachers in Confucian based societies like Korea, Malaysia, Singapore and Taiwan are using ICT for teaching.

A number of findings worth reporting are listed below.

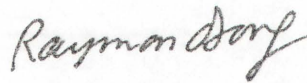
1. Chemistry teachers are using ICT for teaching, but it is not the most frequently used strategy; also, they enjoy the use of ICT-based tools with a transmissionist oriented approach rather than a constructivist one.
2. Chemistry teachers have very positive perceptions that ICT-based tools are useful, and males show statistically significant more positive perceptions than females.
3. Chemistry teachers have positive perceptions that ICT-based tools are easy to use, and males show statistically significant more positive perceptions than females.

4. Chemistry teachers of high ability students, i.e. teachers working in schools with the majority of students belong to the first Territory Band, use more ICT-based tools than other teachers.
5. Chemistry teachers with the highest ICT competence use more ICT-based tools than others.

Plausible explanations of the findings like accountability practices and conflict of beliefs are then presented. At the end of the report, some pragmatic recommendations on how professional development programmes can be organized and the kinds of support chemistry teachers need are presented.

### DECLARATIONS

I hereby declare that this dissertation represents my own work and that it has not been previously submitted to this university or any other institution in application for admission to a degree, diploma or other qualifications.



---

Raymond Wai-hung FONG  
March 2011

### ACKNOWLEDGEMENTS

The completion of this dissertation was accomplished with the advice and support of many people.

I am greatly indebted to Dr Tony HOLLAND and Dr Robert PITHERS for their guidance and generous help in this study.

Thanks are due to the teachers involved in the study.

Special thanks are also due to my wife, Katrina, and my two lovely sons, Nicholas and Trevor, for their constant encouragement, patience and support.

# CONTENTS

		<u>Page</u>
	Abstract	ii
	Declarations	iv
	Acknowledgements	v
	List of Figures	ix
	List of Tables	x
	List of Appendices	xii
Chapter		
1	INTRODUCTION	
	1.1 Background	1
	1.2 Why study teacher beliefs?	7
	1.3 Terminology	11
	1.4 Significance of the study	13
	1.5 Research questions	14
	1.6 Definition of terms	15
2	LITERATURE REVIEW	
	2.1 Development of the use of ICT in education	18
	2.2 ICT in science education	22
	2.3 ICT-based teaching and learning orientations and practices	26
	2.4 Teacher beliefs	32
	2.5 Theory of reasoned action (TRA)	33
	2.6 Theory of planned behaviour (TPB)	35
	2.7 Theory of trying (TT)	38
	2.8 Technology acceptance model (TAM)	39
	2.9 Motivation and personal agency beliefs theory	41
	2.10 Context beliefs	41
	2.11 Evaluation of ITED initiatives in Hong Kong	44
	2.12 Theoretical framework	50
3	METHODOLOGY	
	3.1 Introduction	52
	3.2 Sampling	55
	3.3 Quantitative component – the survey	56
	3.4 Qualitative component – the interviews	64



	<u>Page</u>
3.5	Ethics considerations 66
3.6	Limitations and delimitations 69
4	QUANTITATIVE RESULTS AND INTERPRETATION
4.1	Introduction 71
4.2	Response rate 71
4.3	Teachers' working environment 73
4.4	Teachers' personal attributes 77
4.5	Are teachers using ICT-based tools? 83
4.6	What kinds of ICT-based tools teachers use? 89
4.7	Teachers' perceived usefulness (PU) of the ICT-based tools 94
4.8	Teachers' perceived ease of use (PEoU) of the ICT-based tools 100
4.9	Teachers' context belief (CONTX) of the use of ICT-based tools 104
4.10	Relation of ICT_usage and teacher beliefs 112
4.11	Summary 113
5	QUALITATIVE RESULTS AND INTERPRETATION
5.1	Introduction 114
5.2	Perception of usefulness of ICT-based tools 116
5.3	Perception whether ICT-based tools are easy to use 124
5.4	Experiences with ICT in education 130
5.5	Factors that facilitate or hinder the use of ICT for teaching and learning 137
5.6	Exemplary use of ICT in teaching and learning 147
5.7	Summary 151
6	DISCUSSION AND RECOMMENDATIONS
6.1	Introduction 154
6.2	Key findings and discussion 154
6.3	Recommendations 163
6.4	Limitations of this study 168
6.5	Directions for future research 170

	<u>Page</u>
References	177
List of Appendices	198
Appendices	A2-A15



## List of Figures

<u>Figure</u>		<u>Page</u>
2.1	Cheng & Li's conceptual framework of the use of ICT for science teaching and learning	25
2.2	Teaching modes and learning environment	27
2.3	A summary of the theory of reasoned action	34
2.4	A summary of the theory of planned behavior	36
2.5	A summary of the deconstructed theory of planned behaviour	38
2.6	A summary of the theory of trying	39
2.7	The theoretical framework of the TAM	40
2.8	The theoretical framework of this study	51
3.1	A continuum for analyzing risk for different research methods	68
4.1	Computing ICT_usage scores	84
4.2	ICT_usage scores of subjects	85
4.3	Frequency index of the use of ICT-based tools	89
4.4	Distribution of PU data	95
4.5	Distribution of PEoU data	101
4.6	Recoding of ENABLE and LIKELIHOOD scores	107
4.7	Distribution of recoded ENABLE and LIKELIHOOD scores	108
5.1	Drawings created by teacher F2 with her own library of drawings	125
6.1	Unified Theory of Acceptance and Use of Technology	171

## List of Tables

<u>Table</u>	<u>Page</u>
2.1 BECTA's classification of the use of ICT in science education	24
2.2 Gobbo and Girardi concepts: teaching styles, ICT competence and how ICT is integrated into classroom activities	28
2.3 Characteristics of the instruments for measuring PU and PEOU	40
2.4 Beliefs, capability beliefs and context beliefs	42
3.1 Instruments used by various researchers to solicit information related to teachers' use of technology and beliefs about technology	58
3.2 Computer technology tools examined in TAM based studies	60
4.1 Types of school participated	74
4.2 Distribution of the schools participated	75
4.3 Ability of students in the schools participated	76
4.4 Gender of the subjects	77
4.5 Qualification of the subjects in science	78
4.6 Qualification of the subjects in education	78
4.7 Age distribution of the subjects	79
4.8 Teaching experience of the subjects	80
4.9 Position of the subjects in the Chemistry Department	81
4.10 Correlation of age, teaching experience and position of the subjects in chemistry department	81
4.11 Information technology competency level of the subjects	82
4.12 Frequency of use of the ICT-based tools and frequency index	83
4.13 Descriptive statistics of ICT_Usage	85
4.14 ANOVA of ICT_usage against student ability	86
4.15 Descriptive statistics of ICT_usage and student ability	87
4.16 ANOVA of ICT_usage against ICT competency level	87
4.17 Descriptive statistics of ICT_usage and ICT competency level	88
4.18 Descriptive statistics of PU and PEOU	95
4.19 ANOVA of PU against the variables related to working environment	96
4.20 ANOVA/ <i>t</i> -test of PU against some variables related to personal attributes	96
4.21 Descriptive statistics of PU and gender	97
4.22 <i>t</i> -test of PU against gender	97
4.23 Descriptive statistics of PU and ICT competency Level	98
4.24 ANOVA of PU against ICT competency Level	98

<u>Table</u>	<u>Page</u>
4.25 ANOVA of PEoU against the variables related to working environment	101
4.26 ANOVA/ <i>t</i> -test of PEoU against some variables related to personal attributes	102
4.27 Descriptive statistics of PEoU and gender	102
4.28 <i>t</i> -test of PEoU against gender	102
4.29 Descriptive statistics of PEoU and ICT competency level	103
4.30 ANOVA of PEoU against ICT competency level	103
4.31 Descriptive statistics of ENABLE and LIKELIHOOD	106
4.32 ANOVA of ENABLE & LIKELIHOOD against the three variables related to working environment	108
4.33 ANOVA/ <i>t</i> -test of ENABLE & LIKELIHOOD against the six personal attributes	109
4.34 Descriptive statistics of ENABLE & LIKELIHOOD and gender	109
4.35 <i>t</i> -test of ENABLE & LIKELIHOOD against gender	110
4.36 Descriptive statistics of ENABLE and ICT competency level	110
4.37 Descriptive statistics of LIKELIHOOD and ICT competency level	111
4.38 ANOVA of ENABLE against ICT competency level	111
4.39 ANOVA of LIKELIHOOD against ICT competency level	111
4.40 Correlation of ICT_usage and PU & PEoU	112
4.41 Correlation of ICT_usage and ENABLE & LIKELIHOOD	113
5.1 The attributes of teachers interviewed	115
6.1 Approaches and models for teacher professional development	166

## List of Appendices

<u>Appendix</u>		<u>Page</u>
A	Four levels of IT competency for Hong Kong SAR teachers	A2
B	Consent letter for participation in the questionnaire survey	A3
C	Survey questionnaire	A4
D	Consent letter for participation in the Interview	A10
E	Interview – open-ended questions	A11
F	ICT tools in chemistry education in Hong Kong secondary schools	A12
G	Secondary school statistics (2006-2007)	A14
H	General guidelines for assessing qualifications of science permitted teachers (ED, 1990)	A15